Development of Biobased Composite Materials for Structural Applications

With the increasing global energy crisis and ecological risks, natural fibers and biobased resins have attracted increasing research interests owing to their potential of serving as alternatives to synthetic materials in polymer matrix composites. Natural fibers and biobased resins used in composite materials offer a high-value use for several agricultural products grown in ND including: corn, flax, canola, sugar beet, soybean, sunflower, and switchgrass.

**Natural Fibers as Reinforcement in Composites**

Natural fibers are attractive as reinforcement in polymers because of their availability, recyclability, low price, non-abrasiveness, good insulating properties, and low density leading to high specific strength. **Main Objective:** Determine the technical and commercial feasibility of using natural fibers as reinforcement in composite materials.

**Milestones:**

Produced composite panels out of flax, corn, sunflower, and sugar beet pulp fiber with 15% enhancement of stiffness with as little as 9 wt% fiber loading.

**Vegetable Oils as Thermosetting Polymers**

Vegetable oils can be used to produce liquid molding resins such as epoxy, vinyl ester, and polyester. Currently, epoxy resins produced from canola and soybean oil are being investigated at NDSU. **Main Objective:** Determine the technical and commercial feasibility of producing epoxy resins from canola oil for use in composite materials.

**Milestones:**

Produced epoxy canola oil resin and epoxy canola methyl ester with up to 5.0% and 5.8% oxirane content, respectively.

**Vegetable Proteins as Thermoplastic Polymers**

Vegetable proteins can be utilized to create plastics with properties similar to commodity thermoplastics such as polypropylene and polyethylene. Currently, protein from corn and canola are being considered at NDSU. **Main Objective:** Determine the technical and commercial feasibility of producing a thermoplastic from corn and canola protein for use in composite materials.

**Milestones:**

Canola protein based polymers have been processed with some initial success.

**Processing of Biobased Composite Materials**

The main goal of this program is to assemble a large, multidisciplinary team (academic & industrial) focused on improving the growth, harvesting, treatments, and development of agricultural-based precursors for processing biobased polymer matrix composites in local and regional composite manufacturing facilities for use in a wide range of primary and secondary structural applications.

North Dakota State University (NDSU) and the University of North Dakota (UND), local/regional agricultural materials processors and composite industries, along with ND, MN, and SD regional farmers are in a unique position to become leaders in the research, development, and production of biobased composite materials.

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